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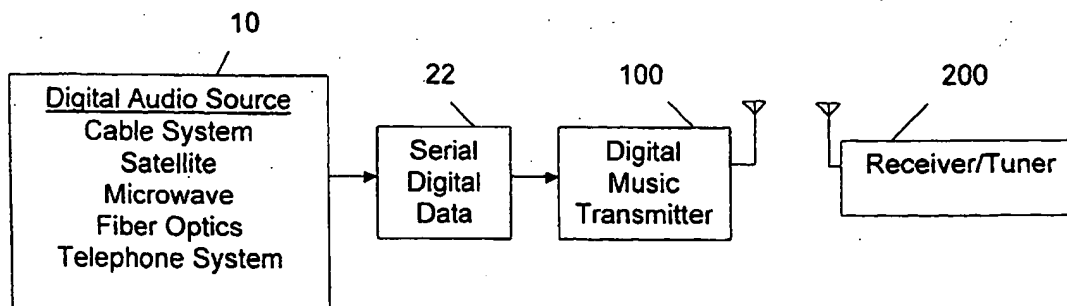
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(54) Title: WIRELESS MUSIC AND DATA TRANSCIVER SYSTEM



(57) Abstract: A method and apparatus for a wireless local transmitter that accepts a plurality of digital audio signals and corresponding program information signals encoded as digital data. The encoded digital data is provided by a source, typically a community antenna television (CATV) cable or direct broadcast satellite, that modulates the encoded digital audio and corresponding program information signals on different carrier frequencies and transmits the modulated signals to a plurality of remote digital receiver/tuners that demodulate and decode the signals to output music in stereophonic sound and display the corresponding program information by means of an alphanumeric display. The transmitting and receiver/tuners contain microprocessor systems for communicating, controlling, storing, processing, display and purchase of digital data within the operation of the respective system. A high speed, error free digital signal protocol is utilized for transmitting digital audio and corresponding program information signals to and from the digital receiver/tuner.



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## WIRELESS MUSIC AND DATA TRANSCEIVER SYSTEM

### BACKGROUND OF THE INVENTION

[0001] The cable television industry developed and refined a process of audio signal compression in the mid-1980's. The process allows for extra space on coaxial cable wire by electronically compressing audio signals between the video bandwidths that carry the television signal. By the later 1980's, audio signal compression technology spawned an industry that has come to be known as "digital music." Digital music is developed by cable conglomerates and is sold to subscribers along with their cable television service. This audio music signal is produced at one location by using multiple compact disc players playing continuous music in a variety of formats then sent via satellite to local cable companies. The audio music service is also currently available as a premium service via direct broadcast satellite (DBS), but other methods, such as fiber optics, telephone systems, microwaves, or Internet enabled technologies for example, could also deliver the signal.

[0002] The local multisystem operators (cable and DBS companies sell the service to subscribers who pay a monthly fee for a headunit or "tuner") compress the signal, then sell the service to subscribers. This unit decompresses the audio signal, then converts it into an analog signal which can be heard through the television audio source or be used in conjunction with a home stereo component system. The user can choose from multiple channels using an infrared remote control or with tuner controls located on the headunit. With the Digital Music Express product, including song title, artist, album, and record label can be viewed on an LCD (liquid crystal display) window located on the infrared remote that operates the tuner as described in U.S. Patent No. 5,445,570. This system to Cook correctly postulates the value of listener access to program information; specifically, that there is a strong possibility for loss of revenue due to subscription cancellation if a subscriber has no method of knowing the program information that corresponds to the song they are listening to. Furthermore, Cook explains that to the music industry, identification of the recording label and the musical selection is critical to the sale of recordings.

[0003] Digital music has not developed as proponents predicted. Since its national introduction in the early 1990's, sales penetration has been an unimpressive 1.5-2.5 percent among the multisystem operators offering the service. Research has revealed that digital audio is a unique product, but with very little recognition among subscribers. And, despite a myriad of marketing schemes, neither operators nor the two major cable audio producers can claim to have found a definitive solution to drive sales.

[0004] The problem with the current product is that it is not versatile. It can only interface with an existing stereo component or loudspeaker system. Subscribers are also bound to a single choice of music located in the room where the converter/tuner box is located. Because the cable music service is not available in the convenience of technology

such as a portable disc player, a portable bookshelf stereo, a portable radio/tape player, or more popular mediums for listening to electronic music, it will never be as attractive as it could be to the consumers who would most appreciate its advantages.

[0005] As mentioned above, presently, the only means to access the audio signal provided by the cable music services is through use of a stationary output device, such as a rack stereo system with auxiliary inputs for the digital music tuner. U.S. Patent No. 5,282,028 entitled "Remote Control for Digital Music Terminal with Synchronized Communications" and U.S. Patent No. 5,455,570 entitled "Methods and Apparatus for Communication Program Data Signals Via a Remote Control Unit" incorporated herein by reference, disclose systems wherein an infrared remote controls and communicates with a digital music tuner. To use the tuner, changing channels or viewing program information, the listener must be close enough in proximity to the tuner to use the infrared remote; this can be frustrating if a variety of formats or program information is of interest to a listener who within sound range but out of the reception range of the remote control. Also, only one music channel can be accessed at a time, limiting all listeners to a single music format. Additionally, if currently available tuners were combined with multiple output devices in a single structure, competing tastes in music preference and volume would contribute to unnecessary costs and unwanted noise pollution. Prior art has recognized the value in wireless stereophonic signals. U.S. Patent No. 4,829,570 to Borchardt describes a F.M. (frequency modulation) signal transmitter/receiver system which is then outputted to loudspeakers. The Borchardt system converts an audio signal into a F.M. signal, transmits the F.M. signal over A.C power lines, and reconverts the F.M. signal into an audio signal which is outputted at the source. The problem with such a device is that it has limited function. Only one signal is sent from the transmitter to the receiver. The receiver must be a stationary device with auxiliary inputs to accommodate the transmitted signal. And, the listener must return to the signal source to change the input. RF Link markets a similar product, Wavecom Jr., that transmits audio and video signals on a gigahertz frequency, but is subject to the same limitations of the Borchardt system. U.S. Patent No. 5,491,839 entitled "System for Short Range Transmission of a Plurality of Signals Simultaneously Over the Air Using High Frequency Carriers" to Schotz discloses a system for transmitting analog or digital signals. Schotz suggests that three electrical input signals be comprised of conventional audio sources, such as a compact disk, or tape deck, but not digital audio or program information to a plurality of receiver/tuners that allow a listener to interact with the music service.

[0006] In general, such prior art systems are limited in range, signal strength, variety of channels, program information available, and overall accessibility and ease of use. Consequently, a requirement exists for a local transmitter and digital receive/tuner system that communicates under a control to provide reception of the digital audio music

and display of corresponding program information which can be located at the convenience and discretion of multiple listeners.

### **OBJECTS OF THE INVENTION**

[0007] It is, therefore, the object of the present to provide a wireless local transmitter and digital receiver/tuner system for transmitting and receiving digital audio and corresponding program information that will overcome the limitations of conventional methods of transmitting and receiving digital audio and corresponding program information.

[0008] It is another object of this invention to provide a transmitter that can receive digital audio and program information input from a plurality of sources and can simultaneously broadcast a plurality of digital audio and program information signals over a limited range.

[0009] It is still another object of this invention to provide a transmitter that can simultaneously broadcast a plurality of digital audio and program information signals via a combined digital signal.

[00010] It is an additional object of this invention to provide receivers that can simultaneously receive a plurality of combined digital audio and program information signals broadcast by the transmitter, and can select one of the digital audio signals and display corresponding program information signals broadcast from the transmitter.

[00011] It is still an additional object of the present invention to utilize an existing clock oscillator having a predefined frequency within a first and second device to enable the transmission and reception of digital audio and program information between the two devices using the predefined frequency to generate a wireless digital carrier signal.

[00012] It is a further object of the present invention to provide a two-way communications link between a plurality of receiver/tuners and the first controllable device which allows the listener to interact with the service with, for example, viewing program information for future use, or purchase of music via electronic accounts.

[00013] It is yet a further object of the present invention to provide an error detecting or an error checking process for receiving an entire, error-free message from a predetermined number of transmissions between a controllable device and a receiver/tuner of a message defined by a predetermined number of data fields.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[00014] The following detailed description, given by way of example, and not intended to limit the present invention solely to the embodiments shown and described herein, will best be understood in conjunction with the accompanying drawings in which:

[00015] FIG. 1 is a schematic representation of the overall transmitter and receiver/tuner system configured in accordance with this invention.

[00016] FIG. 2A is a block diagram of the transmitter of the system.

[00017] FIG. 2B is a block diagram of the transmitter synchronizing circuit.

[00018] FIG. 3 is an example of a top plan view of one variation of the receiver/tuner units constructed in accordance with the preferred embodiments of the present invention.

[00019] FIG. 4 is a block diagram of the receiver/tuner of the system.

### **SUMMARY OF THE INVENTION**

**[00020]** The problems of providing digital audio and display of corresponding program information associated with a digital music service are solved by the principles of the present invention. The present invention ensures that a listener will continue to enjoy the advantages of digital audio, while also enabling portable reception of the service within a localized setting. Also, the invention provides a means for the user to participate in music surveys, store desired program information, and purchase of music via electronic accounts, by combining a wireless receiver/tuner unit that communicates with and controls a first controlled device, such as a digital audio and program information transmitter unit.

**[00021]** A system constructed in accordance with the present invention is comprised of two primary components, a transmitter and at least one receiver/tuner. The transmitter serves as an addressable controller that includes input means, encoders/decoders associated with the system, demultiplexer, service codes, converter means, carrier signal producing means, combining means, and antenna means. The converter contains a digital to RF (radio frequency) converter module, demodulator, addressable control interface logic, subscriber interface logic, and decryptor. The input means is arranged for receiving a multiplexed serial digital data audio/program information stream that includes a plurality of the digital audio, program information, and national subscriber information signals from said multiplexed serial stream.

**[00022]** The carrier signal producing means is arranged for providing at least a first group of carrier signals, with that group comprising a set of different carrier signals. Each of the carrier signals of the group is preselected and is different from the others of the group, and is at a frequency of at least 900 MHz.

**[00023]** The modulating means is coupled to the input means for modulating the carrier signals of the first group with respective ones of the plurality of input signals to produce a plurality of modulated carrier signals. The serial stream is modulated using multiphase or multilevel amplitude or frequency modulation of the carrier in the F.M. broadcast band. The means for combining is coupled to the modulating means for combining the modulated carrier signals into a combined signal and for providing the combined signal to the antenna means. The antenna means radiates the combined signal over the air.

**[00024]** The receiver/tuner is a device consisting of subcomponents including a microprocessor, addressable controller interface logic, RF to digital converter, signal amplifier, tuning synthesizer, subscriber interface logic, LCD display, demodulator, local oscillator, keypad interface, and output amplifier. The receiver means is arranged for receiving the combined signal and for demodulating a selected one of the carrier signals in the group so that the input signal is extracted therefrom for reproduction by transducer means coupled to the receiver means.

[00025] The transmitter means provides plural groups of different carrier signals comprising plural carrier signals which are different from the other signals in that group and from the carrier signals in the other groups and are of a frequency of at least 900 mHz. First user-selectable means are provided in the transmitter means and in the receiver means to select a desired group of carrier frequencies for system operation. Second user-selectable means are provided in the receiver means to enable the user to select a desired carrier frequency of the selected group to be demodulated so that they can hear the digital audio and view the program information signal extracted therefrom by such demodulation. The multiple groups of carrier frequencies available enables a selection of a group of carrier frequencies which are different from those which may be used by another like system operation within the operating range of the system to ensure that there will be not interference by that other system.

### **DETAILED DESCRIPTION OF THE INVENTION**

[00026] Referring now to FIG. 1, FIG. 1 illustrates a system for local wireless transmission and reception of digital audio and program information. A delivery system 10, such as coaxial cable, satellite, the Internet, microwave, and etc., outputs a serial digital audio/program information stream 22 that contains digital audio, program information, and national subscriber information. The transmitter 100, more fully described with respect of FIGS. 2A-2B, receives the said serial digital data stream 22 and demultiplexes, decrypts, and decodes the digital audio and program information signal. The digital audio signal and program information are converted to digital RF carrier frequencies and broadcast to a plurality of second devices, preferably at least one receiver/tuner unit 200, more fully described with respect to FIGS. 3-4, that outputs the selected audio electronically and displays the corresponding program information of the audio track currently listened to by the subscriber.

#### **Digital Music Transmitter**

[00027] Referring now to FIG. 2A, FIG. 2A illustrates a block diagram of the preferred digital music transmitter (DMT) 100. Referring to FIGS. 1-2B, the serial digital data stream 22 is passed via an established system of digital data distribution 10, for example, multisystem operator's coaxial cable or direct broadcast satellite, and is received by the transmitter input terminal 105. The transmitter input terminal 105 preferably includes phase-lock loop (PLL) circuitry. The signal is amplified by an amplifier 110 and filtered by a SAW filter 115 before being demodulated by a demodulator 120. The demodulator 120 converts the selected digital frequency to demodulation intermediate frequency (IF). The output of the demodulator 120 is quadrature partial response (QpR) demodulated to produce a 5.6 Mbps data stream containing 150 stereo pair of digital audio data to an applications specific integrated circuit (ASIC) 130. The demodulator 120

provides data to a data clock recovery PLL 125. The data clock recovery PLL 125 contains a 33.8688 mHz crystal 122 (about 33.9 mHz) for timing purposes.

[00028] The ASIC 130 provides demultiplexing, decrypting, and decoding operations upon the 5.6 Mbps data stream input by the demodulator 120 to the microprocessor 140. The ASIC 130 separates the 5.6 Mbps data stream to a select one of 150 stereo pairs of digital audio signals. The selected stereo pair is decrypted and separated to provide digital audio signal and a program information signal. The digital audio signal is then decoded according to a variety of known techniques. The ASIC 130 inputs the digital RF converter 150. The audio signals are provided to an F.M. stereo encoder and loudness processor 152, and then to F.M. band exciter 154. The output of the exciter 154 is amplified by a high power amplifier 156 and broadcast over the airwaves by an antenna 160 as digital F.M. in the F.M. broadcast for reception by a digital F.M. receiver 201, such as disclosed in FIG. 3. A receiver 170 for a second controllable device, such as a digital receiver/tuner (DRT) 200, coupled to the microprocessor 140 receives instruction or control signals transmitted by the DRT 200 to initiate the remote control of selected functions of the transmitter 100. A clock signal generated internal to the ASIC 130 is utilized as a carrier signal to switch the output of the DRT 200 ON or OFF at a frequency of 44.1 KHz. The 44.1 KHz clock from an ASIC Clock generator 130A may be utilized to generate a carrier signal for RF signals sent by the DRT transmitter 160. The ASIC Clock signal provided by the ASIC clock 130A is derived from the about 33.9 mHz signal provided to the ASIC 130 by the data clock PLL 125. The DRT 200 operates to control selected function of the transmitter as well as the program information transmitted by the DRT transmitter 160 associated with the DMT 100.

[00029] The ASIC Clock signal provided by the ASIC clock 130 is derived from the about 33.9 mHz signal provided to the ASIC 150 by the data clock PLL 125. Specifically, the ASIC Clock signal is derived by dividing the 33.9 mHz signal by three (3) to provide a second clock signal having a frequency of 11.3 mHz, and by then dividing the 11.3 mHz signal to the preferred fixed first frequency for the 44.1 kHz ASIC Clock signal. The 11.3 mHz clock signal is utilized as a clock signal selected operations conducted by the ASIC 130. The ASIC 130 contains a synchronizing circuit 132 which is utilized to provide clock synchronized program information signals to the DRT 200. The synchronizing circuit 132 operated to provide two separate timing alignment functions. First, the synchronizing circuit 132 aligns the program information signal provided by the microprocessor to the 11.3 mHz clock signal. Second, the synchronizing circuit 132 aligns the 44.1 KHz ASIC Clock signal to the 11.3 mHz clock signal.

[00030] Referring now to FIGS. 2A-2B, the synchronizing circuit 132 includes a first synchronizing element 133, an edge detector 134, and second synchronized element 135, and gate 136. The microprocessor 140 provides program information signals in the



form of a serial data signal formatted in the appropriate display information protocol to the first synchronizing element 133. The microprocessor 140 outputs the program information signals to the first synchronizing element 133 at a predefined data rate, preferably 4900 baud. In addition, the 11.3 mHz clock signal is provided as another input to the first synchronizing element 133. The first synchronizing element 133 aligns the rising edge of the program information signals to the 11.3 mHz clock signal to provide an output signal synchronized with the 11.3 mHz clock. The second synchronizing element 135 accepts the synchronized output signal of the first synchronizing element 133 and produces a gate signal when the output signal of the edge detector 134 enables the second synchronizing element 135. The gate signal produced by the second synchronizing element 135 and the ASIC clock signal of 44.1 kHz are provided as inputs to an AND gate 136. Accordingly, the integral numbers of cycles of the ASIC clock signal output by the AND gate 136 is effectively determined by the pulse width or pulse duration of the gate signal output by the second synchronizing element 135.

[00031] The output of the ASIC 130 is a carrier-modulated program information signal, produced by an on/off keying technique, and is provided from the synchronizing circuit 130 on line 137 to the DRT transmitter 160. The carrier-modulated program information signal, when formatted with appropriate start bits, stop bits, and other formatting information described below, comprises a display information signal that is ultimately displayed as alphanumeric characters on the display of the DRT 200. The DRT transmitter 160 is responsive to the carrier-modulated program information signal provided on line 137. The microprocessor 140 initiates a transmission of a program information signal by the DMT 100. In response to the initiation of a transmission, the ASIC 130 outputs the synchronized program information signal at the rate defined by the first frequency (44, 1KHz) to the DRT transmitter 160.

[00032] The DRT receiver 170 includes a demodulator 172 and RF diode 174. The RF diode 174 is located between an input of the demodulator 172 and the ground. When the RF diode 174 detects a command signal from the DRT 200, the RF diode 174 outputs a detected signal to the demodulator 172. The demodulator 172 demodulates and filters the detected RF signal and provides an output voltage signal to the receiver input terminal of the microprocessor 140 on line 173. The demodulator 172 provided the specific functions preamplification, bandpass filtering, and detection of the detected RF signal provided by the RF diode 174.

#### Digital Receiver/Tuner

[00033] Referring now to FIG. 4, FIG. 4 illustrates a block diagram of the preferred digital receiver/tuner (DRT) unit 200. The preferred DRT units, not limited to the embodiments illustrated in FIG. 3, include a display for the control of the digital music transmitter (DMT) 100. The top surface of the DRT 200 includes an alphanumeric

character display and a matrix of contact switches forming a keypad. Each contact switch of the keypad is covered by a push button or key that includes a label which defines the function or instruction initiated when the user presses the push button. In addition, selected areas of the tip surface of the DRT unit include labels or other indicia that further designate the function or instruction associated with the key or push button. The user can control the functions of the DMT 100 in a manner similar to the use of currently popular wireless transmitter/receiver units that control the functions of consumer products, such as cordless telephones or local audio signal transmitter.

**[00034]** Specifically, the DMT 100 remains in a dormant mode with a transmitted passive signal that responds to a selected command function from the DRT unit 200. The user can initiate or terminate transmission of the digital audio and program information from the DMT 100 by pressing a selected key. Each of the buttons or key of the keypad is labeled to indicate the function associated with the key.

**[00035]** For example, by pressing any key or a set of keys labeled with Arabic numerals 0-9, a user can select one of the available digital audio and program information channels transmitted by the DMT 100 for the listening pleasure of the subscriber. The keys labeled TUNE (up arrow) and TUNE (down arrow) may be used by the listener to the increment or decrement the digital audio and program information channels transmitted by the DMT 100. In a similar fashion, a volume up (VOL up arrow) and a volume down (VOL down arrow) keys can be utilized to control the volume level provided by the DMT 100. An ON/OFF key with a power indicator light may be utilized by the listener to either power on or off the DRT 200 and DMT 100 signal transmission. Also, a MUTE key is useful for eliminating the audible portion of the program provided by the DMT 100. Those persons skilled in the art will appreciate that such control functions are similar to the control function provided by other wireless remote controls for consumer products.

**[00036]** Other control functions related to the control of the DMT 100 by the DRT unit 200 include control functions associated with the keys ENTER/NEXT, PRESET and MODE. By pressing the ENTER/NEXT key, the user initiates a command function that may be associated with the various functions of the DRT unit 200. The PRESET key permits the user to store a favorite digital audio channel for future operations by the DRT unit 200. The MODE function changes the message field on the LCD viewscreen according to the function selected by the user, for example viewing or storing program information for a current music selection, participating in music surveys, or purchase of music via electronic account.

**[00037]** The listener can also review the program information associated with a current program by inputting an information request for transmission to the DMT 100. By pressing the VIEW key, the user initiates the transmission of an information request by the DRT unit 200 to the DMT 100. The DMT processes the information request and initiates a

search for program information associated with the current program. If the program information is not found by the DMT within a predetermined timer period, typically about five seconds, the DMT 100 will respond to the transmitted information request by transmitting an error message to the DRT unit 200. If the search by the DMT 100 is successful, the DMT 100 will respond to the transmitted information request by transmitting the program information to the DRT unit 200. With respect to digital audio signals, a typical program message includes information concerning the composer, the track title, the artist, the album associated with the track title, and custom information concerning the current performance.

[00038] Referring again to FIG. 4, the preferred DRT unit 200, which includes a processor 240, preferably a microcomputer or microcontroller, having on-board mask programmed memory, such as a read only memory (ROM) 240A. The memory 205A comprises a plurality of memory locations for storing parameters associated with different control signal protocols (in particular, for storing a plurality of parameters associated with different control protocols for different controllable devices). The preferred DRT unit 200 further includes RF receiver 201, demodulator 218, an applications specific integrated circuit ASIC 230, digital/audio converter 270, transmitter 260, a data clock recovery PLL 225, front panel interface 250, and stereo output amplifier 280.

[00039] The output of the demodulator 218 is quadrature partial response (QpR) demodulated to produce a 5.6 Mbps data stream containing 150 stereo pairs of digital audio data to the ASIC 230. The demodulator provides data to a data clock recover PLL 225. The data clock recovery PLL 225 contains a 33.8688 mHz crystal 122 (about 33.9 mHz) for timing purposes. In one embodiment, the DMT 100 control signal protocols are stored in the ROM 240A. The control protocol includes the properly formatted codes associated with control functions for the DMT 100.

[00040] The ASIC 230 provides demultiplexing, decrypting, and decoding operations upon the 5.6 Mbps data stream input by the demodulator 218 to the microprocessor 170. The ASIC 230 separates the 5.6 Mbps data stream to a select one of 150 stereo pairs of digital audio signals. The selected stereo pair is decrypted and separated to provide a program information signal and a digital audio signal. The digital audio signal is then decoded according to a variety of known techniques. The ASIC 230 inputs the digital audio and program information signals, provided at a sampling rate of 44.1 kHz, to a digital/audio converter 270, transmitter control 260, and microprocessor memory 240A. The demultiplexed control and channel data separated out from the data stream by the ASIC 230 are provided to a microprocessor 240 which controls the overall operation of the DRT unit 200.

[00041] A clock signal generated internal to the ASIC 230 is utilized as a carrier signal to switch the output of the DRT 200 ON or OFF at a frequency of 44.1 KHz. The

44.1 KHz clock from an ASIC Click generator 230A may be utilized to generate a carrier signal for RF signals sent by the DRT transmitter 160. The ASIC Clock signal provided by the ASIC clock 230A is derived from the about 33.9 mHz signal provided to the ASIC 230 by the data clock PLL 225. The DRT 200 operates to control selected functions of the DMT 100 as well as the program information transmitted by the DRT transmitter 260 associated with the DMT 100. Referring again to FIG. 2A, the ASIC Clock signal provided by the ASIC clock 230A is similar in function and purpose to that of the aforementioned ASIC clock 130A. As result, the 11.3 mHz clock signal is utilized as a clock signal selected operations conducted by the ASIC 230.

[00042] Referring again to FIG. 4, for a first operation mode, digital audio and program information carrier signals are received by the receiver antenna 201 from the DMT transmitter 160. The received signal is provided to a double tuned tracking filter (DTTF) with PLL circuitry, from there to an amplifier 203, on to a single tuned tracking filter (STTF) 205, a mixer 207, and SAW filter 209, and into a demodulator 218, according to known techniques. The channel selection process is under control of a tuning synthesizer 220, integrating amplifier 217, STTF 215, and amplifier 212, interconnected as shown and impressing an appropriate signal on a line 211 to the DTTF 201, STTF 205, and oscillator 210 to affect channel selection, according to known techniques. The program information signal from the ASIC 230 is sent to the microprocessor 240 where it may be displayed on the front panel interface 250. The ASIC 230 also sends the program information signal to the transmitter interface 255 and transmitter control 260 for transmission to the DMT 100. Channel selection is provided by the infrared received and/or front panel interface 250, which information is passed on by the microprocessor 240 to the tuning synthesizer 220.

[00043] The ASIC 230 inputs the digital audio and program information signals, provided at a sampling rate of 44.1 kHz to a digital/audio converter 270. The output of the D/A 270 device is provided as a data stream over a bus to a logic circuit 274 which separates the data stream into control bits and channel indication (tag bits) and encrypted digital audio bits (demultiplexing functions) and decrypts the digitized audio data into a suitable form for a Dolby decoder 278. The audio data is decrypted into three serial streams per audio channel consisting of basic delta modulation parameters for "left" and "right" channels. The output of the Dolby decoder 278 is provided as "left" and "right" audio channels to a stereo amplifier 280, and to stereo outputs for use with standard audio components.

[00044] From the foregoing description of one embodiment of the invention, it will be appreciated that the present invention overcomes the disadvantages of the prior art and achieves the objects and advantages of the invention recited above. Accordingly, the embodiments of the present invention improve existing methods of providing digital music by making the service more convenient and accessible to subscribers through wireless

transmission of music to remotely located devices. Greater recognition among subscribers is gained by similarities of an embodiment of the present invention to more popular consumer electronic music devices. And, digital music is made more versatile with improved methods of subscriber interaction with the service. The above description of the embodiments of the invention is intended to be illustrative and not limiting. Various changes or modifications in the embodiments described may occur to those skilled in the art and these can be made without departing from the spirit or the scope of the invention.

## CLAIMS

What is claimed is:

1. A wireless digital audio transceiver for receiving a locally broadcast digital audio signal wherein the digital audio signal comprises a carrier wave with digital audio data and audio program information, the transceiver comprising:
  - a user interface for selecting one of a plurality of digital audio signals;
  - a tuner operably coupled to the user interface capable of tuning to a frequency associated with a selected digital audio signal and receiving the digital audio signal;
  - a demodulator coupled to the tuner for extracting the digital audio data and the audio program information from the carrier wave; and
  - a digital to analog converter converting the digital audio data into an analog signal and sending the analog signal to an output.
2. A wireless digital audio transceiver according to claim 1, wherein the transceiver is portable.
3. A wireless digital audio transceiver according to claim 1, wherein the transceiver is handheld.
4. A wireless digital audio transceiver according to claim 1, further comprising:
  - a decompression module for decompressing the digital audio data.
5. A wireless digital audio transceiver according to claim 1, wherein the user interface is capable of initiating a request for a digital audio signal, the user interface is electrically coupled to a transmitter which broadcasts the request.
6. A wireless digital audio transceiver according to claim 1, wherein the digital audio signal contains multiple programs each including digital audio data and program information.
7. A wireless digital audio transceiver according to claim 6, wherein the transceiver further comprises a demultiplexer.
8. A wireless digital audio transceiver according to claim 7, wherein the user interface includes a switch electrically coupled to the demultiplexer for selection of one of the programs.
9. A wireless digital audio transceiver according to claim 6, wherein the transceiver further comprises a digital signal processor.

10. A wireless digital audio transceiver according to claim 9, wherein the digital signal processor performs demultiplexing.
11. A wireless digital audio transceiver according to claim 9, wherein the digital signal processor performs decrypting.
12. A wireless digital audio transceiver according to claim 1, further including a processor.
13. A wireless digital audio transceiver according to claim 12, wherein the processor receives from the demodulator the program information and provides the program information to the user interface in a displayable format.
14. A wireless digital audio transceiver according to claim 12, wherein the user interface is capable of user selection of one of a plurality of modes.
15. A wireless digital audio transceiver according to claim 14, wherein selection of one mode causes storing music origination data to memory associated with the processor.
16. A wireless digital audio transceiver according to claim 14, wherein selection of one mode causes the processor to display the audio information data.
17. A wireless digital audio transceiver according to claim 14, wherein selection of one mode causes the processor to initiate the sending of a signal to purchase the digital audio data.
18. A wireless digital audio transceiver according to claim 14, wherein selection of one mode causes the processor to transmit subscriber information.
19. A wireless digital audio transceiver according to claim 14, the user interface has a user selectable input which causes the processor to send a request for an audio information signal.

20. A wireless digital audio player for operation in a local environment comprising:
- a user interface providing for selection of a digital audio program;
  - a tuner for tuning to a radio frequency signal associated with the digital audio program;
  - a demodulator for receiving from the tuner a radio frequency signal and demodulating the radio frequency signal wherein the radio frequency signal carries digital audio data and program information;
  - a processor coupled to the user interface for demultiplexing the digital audio data in response to a selected digital audio program separating program information from audio data; and
  - a digital to analog converter converting the audio data corresponding to the selected digital audio program into an analog signal and sending the analog signal to an output.
21. The wireless digital audio player according to claim 20, wherein the user interface has a switch for user activation of a control signal, the control signal requesting the sending of digital audio data, and a transmitter coupled to the user interface for sending the control signal.
22. The wireless digital audio player according to claim 21, wherein the user interface provides a display for displaying program information corresponding to a digital audio program.
23. The wireless digital audio player according to claim 21, wherein the user interface provides a key for sending a control signal for the purchase of the selected digital audio program.
24. The wireless digital audio player according to claim 21, wherein the user interface provides a key for at least transmitting a signal containing account information.
25. The wireless digital audio player according to claim 24, the user interface provides a key for accessing an electronic account.
26. The wireless digital audio player according to claim 25, wherein the user interface contains a display which provides for display of information about the electronic account.



27. The wireless digital audio player according to claim 26, wherein the user interface has a key which allows for purchase of music using the information of the electronic account.

28. The wireless digital audio player according to claim 21, wherein the user interface provides a keypad for selection of a digital audio program.

29. The wireless digital audio player according to claim 21, wherein the user interface provides a keypad for responding to a music survey wherein the received radio frequency signal carries music survey data.

30. The wireless digital audio player according to claim 21, wherein the user interface provides for selection of one of a plurality of frequency groups and wherein based upon the selected frequency group and the selected digital audio program, the tuner is adjusted to receive a radio frequency.

31. A digital music transmitter comprising:  
a transmitter input receiving a plurality of digital audio data streams;  
a demodulator for demodulating each of the digital audio data streams;  
a carrier signal generator generating a plurality of groups of carrier signals, each carrier signal on a distinct frequency;  
a modulator for modulating each digital audio data stream on a carrier signal from each of the groups of carrier signals;  
a combiner for combining each of the carrier signals into a combined signal and outputting the combined signal to an antenna.

32. A digital music transmitter according to claim 31, further comprising:  
a coding module which is capable of decoding a digital audio data stream.

33. A digital music transmitter according to claim 31, further comprising:  
a processor receiving each digital audio data stream and associating digital audio information with each digital audio data stream.

34. A method for transmitting digital music data and related digital program information, the method comprising:  
combining the digital music data and the digital program information into a digital program;  
modulating the digital program on a carrier wave producing a signal; and  
transmitting the signal at a power level so that the signal is broadcast locally.

35. A method for playing music in a wireless digital music player, the method comprising:

- receiving a locally transmitted radio frequency signal;
- demodulating digital data from the radio frequency signal;
- separating the digital data into digital audio data and program information data;
- converting the digital audio data into an analog signal;
- providing the analog signal to an output; and
- displaying the program information corresponding to the analog signal that is output.

36. A method for playing wireless digital music according to claim 35, further comprising:

- decompressing the digital audio data.

37. A method for playing wireless digital music according to claim 35, further comprising:

- selecting a mode of operation for the wireless digital music player.

38. A method for playing wireless digital music according to claim 35, further comprising:

- sending a control signal to begin broadcasting digital audio data and corresponding program information.

39. A method for playing wireless digital music according to claim 35, further comprising:

- sending a control signal to a digital audio transmission system indicating user information.

40. A method for playing wireless digital music according to claim 35, further comprising:

- decrypting the digital data.

41. A method for playing wireless digital music according to claim 37, wherein the mode of operation is playing digital music received in a radio frequency signal.

42. A method for playing wireless digital music according to claim 35, further comprising:

- demultiplexing the digital data into a plurality of digital audio data and program information data signal pairs.

43. A method for playing wireless digital music according to claim 42, further comprising:

- selecting a digital music program; and
- performing the act of separating on a signal pair that corresponds to the selected digital music program.

44. A method for playing wireless digital music according to claim 37, wherein the mode of operation causes the storing of program information data in memory associated with the wireless digital music player.

45. A method for playing wireless digital music according to claim 44, wherein the program information is associated with a memory location designating a favorite digital music program.

46. A method for transmitting digital music data according to claim 34, wherein at least some of the digital music data originates from a computer server.

47. A method for transmitting digital music data according to claim 34, wherein at least some of the digital music data originates from a satellite transmission.

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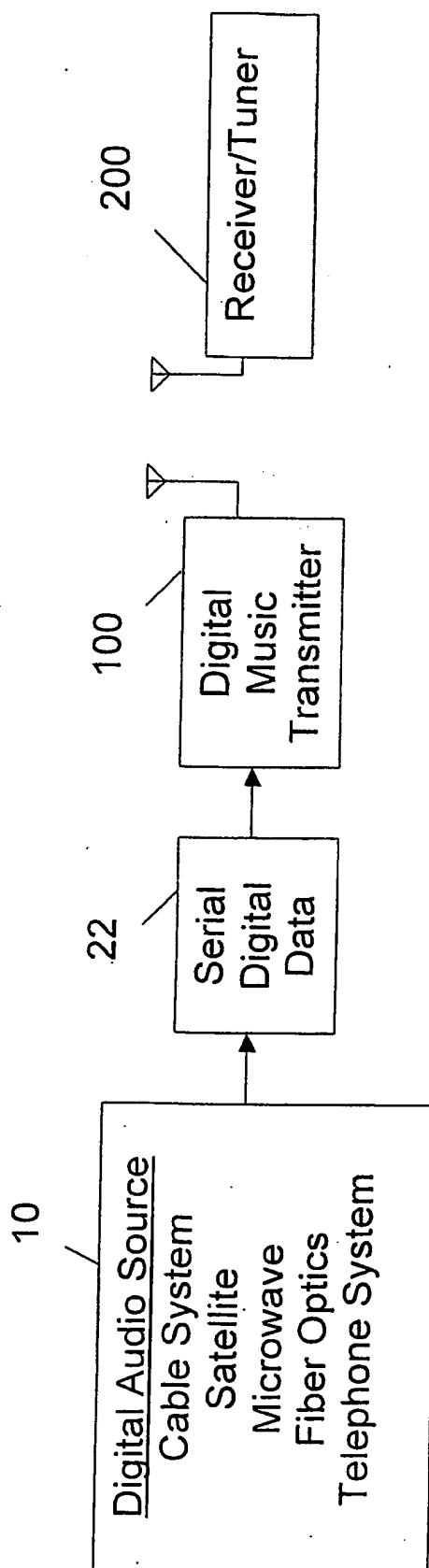


Fig. 1

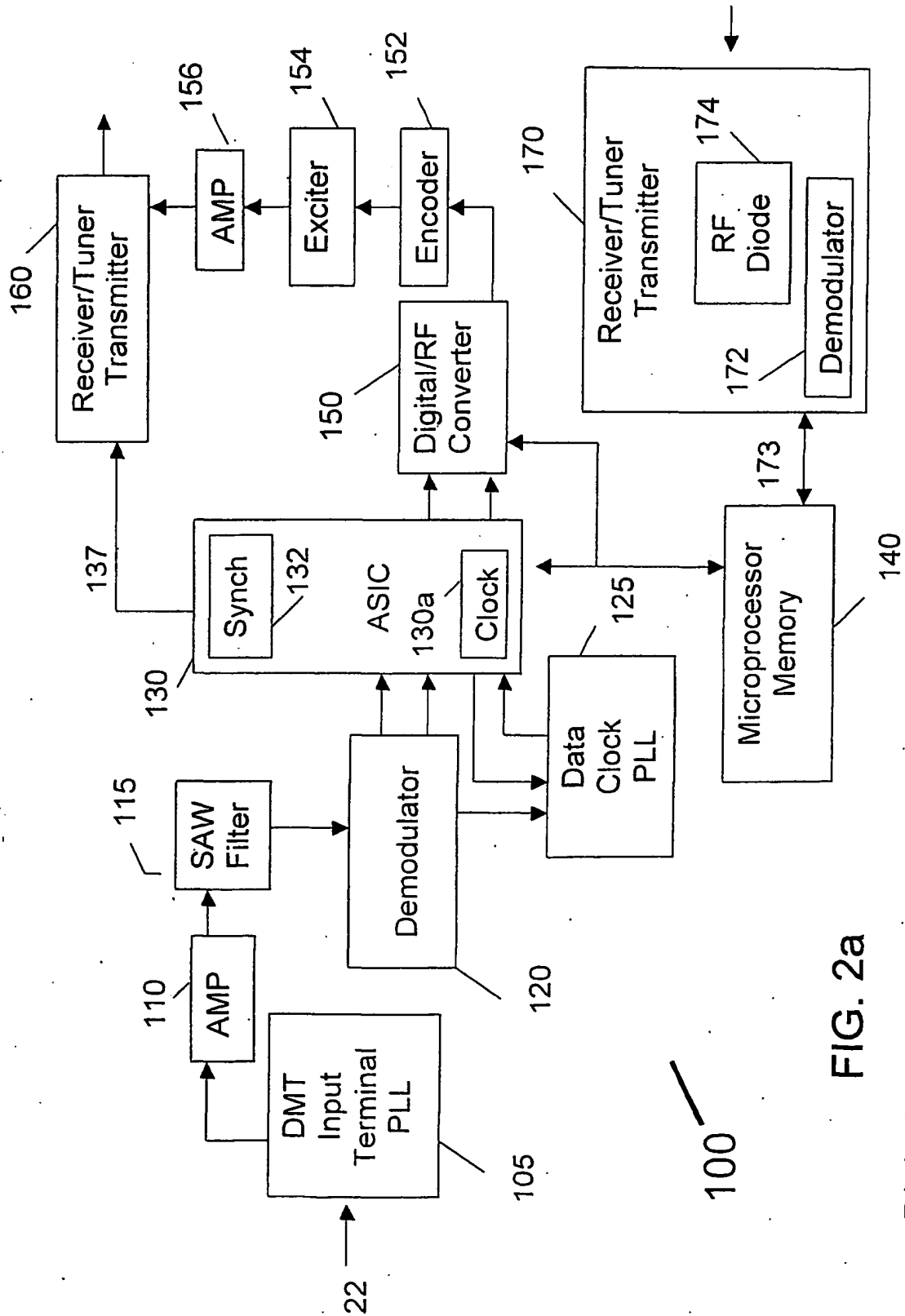


FIG. 2a

Digital Music Transmitter

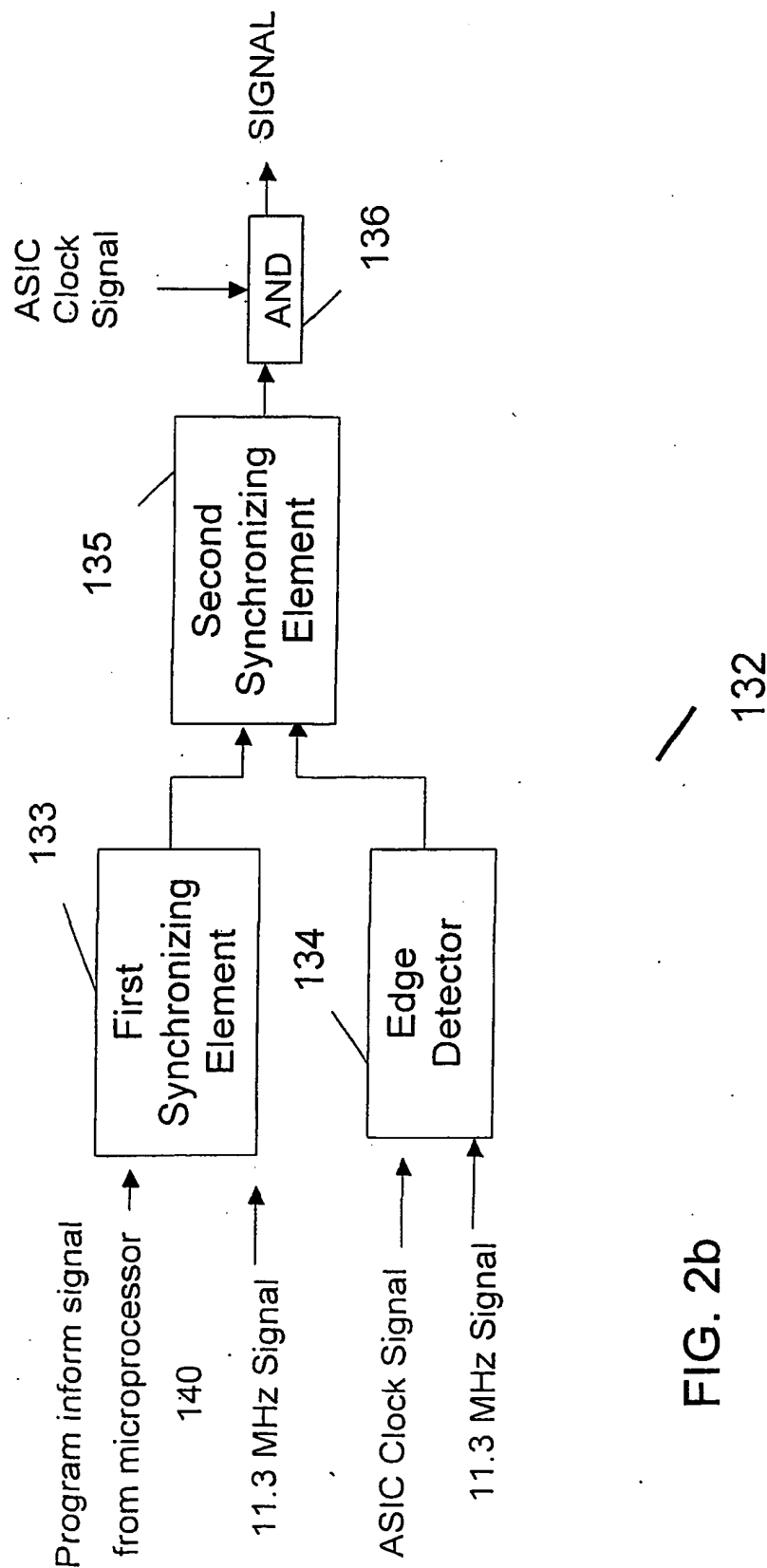
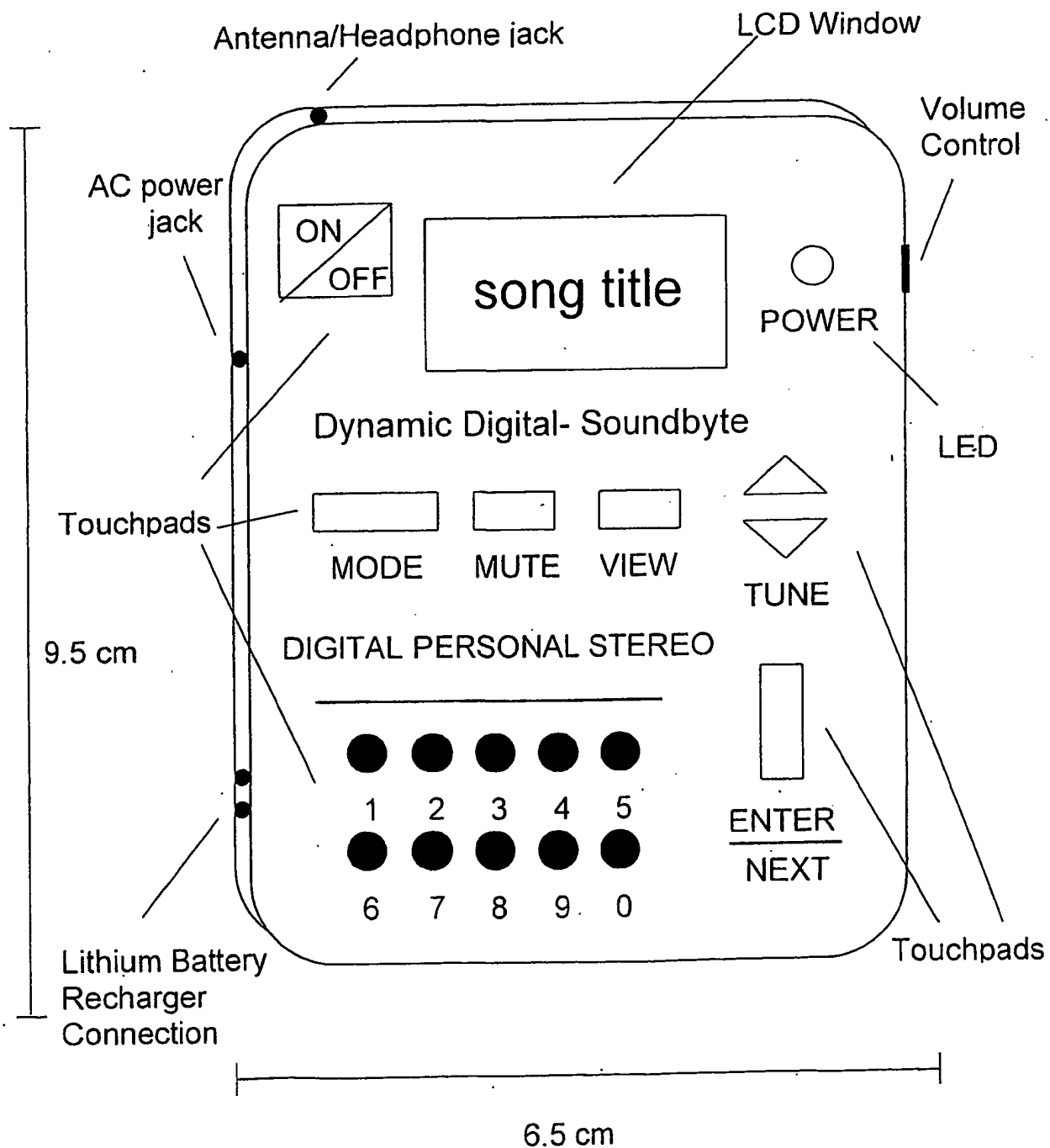
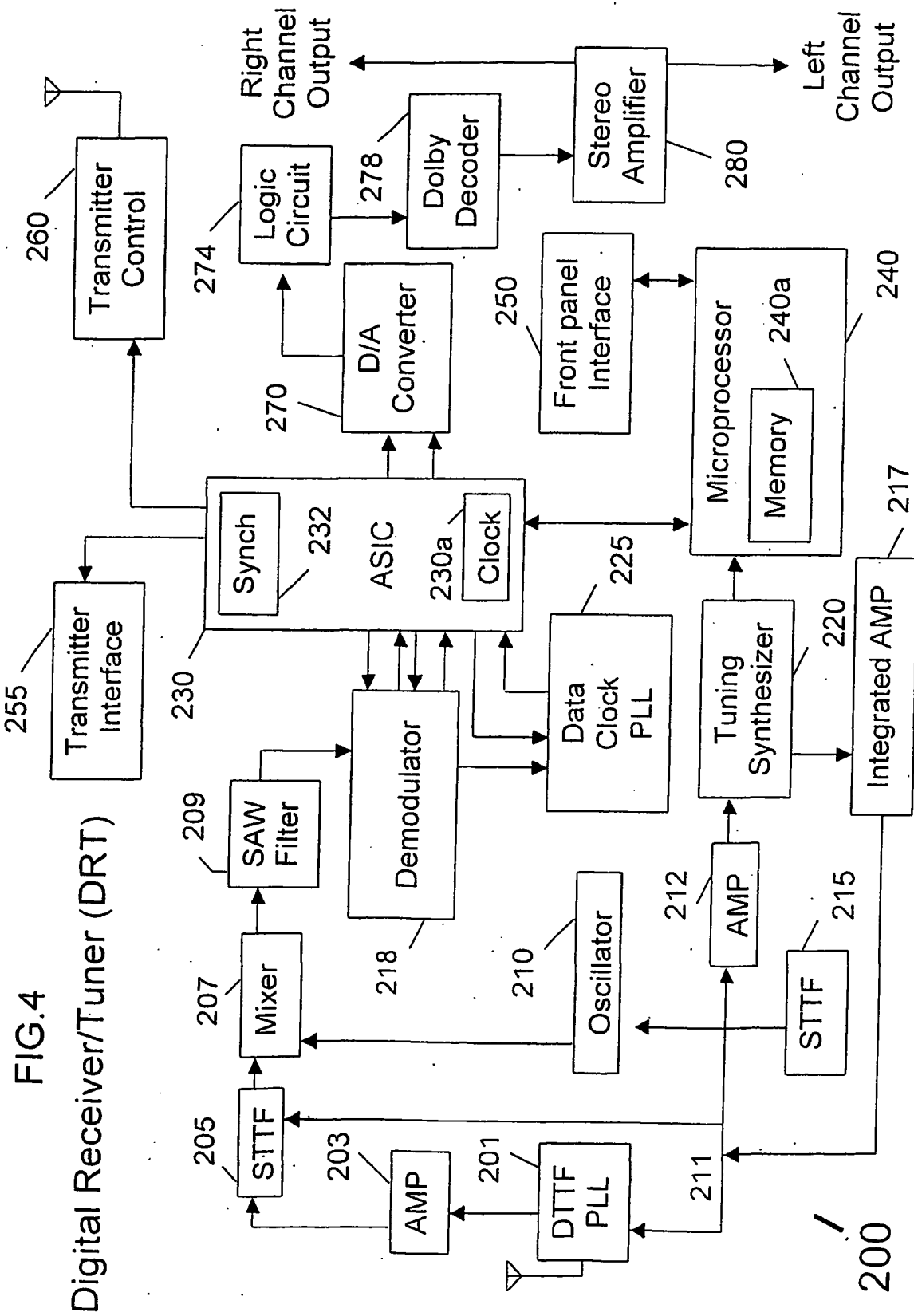


FIG. 2b

FIG. 3

## Receiver/Tuner - Top View







## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 02/06386

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04N7/20 H04H1/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04N H04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, COMPENDEX

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	HOFMEIR S: "SAT-EMPfang FUEr DEN ZWEITFERNSEHER" FUNKSCHAU, FRANZIS-VERLAG K.G. MUNCHEN, DE, vol. 69, no. 9, 11 April 1997 (1997-04-11), pages 68-71, XP000694894 ISSN: 0016-2841 the whole document	1-47
Y	EP 1 022 873 A (SONY CORP) 26 July 2000 (2000-07-26) column 5, line 18 -column 7, line 23; figure 3  -/--	1-47

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

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## INTERNATIONAL SEARCH REPORT

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A	WO 98 26520 A (WICKMAN JOHAN ;BENGTTSSON ROGER (SE); TELIA AB (SE)) 18 June 1998 (1998-06-18) page 7, line 3 -page 8, line 29 ----	1-47
A	EP 0 939 506 A (SHARP KK) 1 September 1999 (1999-09-01) figure 1 -----	1-47

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